論文の内容の要旨

論文題目　The impact of rural context on suicide mortality and its potential mechanisms: A Swedish registry-based multilevel cohort study focusing on country of birth
(農村に住むことが自殺に与える影響とそのメカニズムの検討：出身国に着目したスウェーデンのレジストリ・データを用いた縦断研究)

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Some countries have high suicide rates in rural areas, but there is limited research on the underlying mechanisms. In Chapter 1, to understand geographical variations in health outcomes, I introduced a conceptual framework for understanding the "place effect" on health by Macintyre and colleagues, which consists of compositional, contextual, and collective explanations. As a statistical method to analyze compositional/contextual effects, multilevel analyses that can simultaneously model variables at the regional and individual levels are useful.

Furthermore, urbanization is closely related to international migration issues. In Sweden, where immigration has been increasing, dispersion policies have directed refugees to live in rural areas to prevent their concentration in urban areas and in order to counter the effects of economic decline and population loss in rural areas. The same processes are also occurring in other countries against a global backdrop of increasing international migration. Contextual factors varying by residence in rural or urban areas may have different effects on the suicide of residents by nativity. Therefore, studying cross-level interaction effects between residence and country of birth is important.

Another focus is geographic units to assess rurality. Measures of rurality at different levels of aggregation may reflect different contextual features, and different potential mechanisms might be implicated. The municipality level, which is the smallest politically independent unit of aggregation in Sweden, may reflect variations in the consequences of urban-rural political decisions. When evaluating rurality at smaller units of aggregation, such as neighborhoods or areas within municipalities, an excess suicide risk among particular groups in rural areas might represent interpersonal factors, such as one's social network.

To date, many of the studies that have investigated regional differences in suicide rates by rurality have had an ecological design, and there have been few studies that have used individual-level data to explore the mechanisms that link rurality to suicide. In particular, no study has focused on differences in geographic units and

examined different geographic units simultaneously. In addition, suicide has rarely been studied from the perspective of the dynamics of rural and immigrant populations. Although suicide is a relatively rare outcome, making it difficult to study using individual-level data, the recent promotion of the Nordic registry database has made it possible to conduct large-scale cohort studies. In connection with this, while undertaking my research I collaborated with the Studies of Migration and Social Determinants of Health (SMASH) project team at Stockholm University, Sweden.

This dissertation has aimed to elucidate the urban-rural differences in suicide in Sweden from three perspectives: the country of birth of the residents, the areal unit used to evaluate rurality, and the link to sociodemographic factors. We conducted two types of registry-based cohort study covering the total Swedish adult population. Study 1 aimed to examine the impact of rural living on suicide mortality by country of birth and whether individual characteristics explained urban-rural differences in suicide rates. In Study 2, focusing on the changes in rural areas in recent decades, specifically the increase in the refugee/immigrant population, we aimed to elucidate the 25-year trend in urban-rural differences in suicide mortality and determine area-level factors that could explain the differences.

In Study 1, we set the baseline population with information on their residential address in 2011 (n= 9,482,855). We analyzed people 20 years or older at baseline. The baseline year was 2011 and the followed up continued until either a person's suicide, censoring, or the end of the follow-up in 2016, whichever came first. We used municipality-level and neighborhood-level rurality indicators, and used the municipal classification established by the Swedish Association of Local Authorities and Regions in 2017. Our definition of neighborhood was based on the Demographic Statistical Area (DeSO) area-level measure, developed by Statistics Sweden. In addition, we used individual sociodemographic characteristics, including marital status, education, employment status, and individual disposable income quintile. We calculated Incidence Rate Ratios (IRRs) comparing suicide incidence by nativity using three-level (individuals, neighborhoods, and municipalities) Poisson regression, stratified by gender.

Among men, residing in rural areas was associated with high IRR of suicide regardless of nativity, compared to residing in urban areas. When evaluating rurality at the municipality level, we observed increased suicide risks of living in rural areas among men born in other European (IRRs of residing in rural neighborhoods: 1.39) and other Nordic (1.37) countries, followed by native Swedes (1.22). At the neighborhood level, rurality was associated with increased suicide risk in men from all countries of birth, with the foreign-born men generally showing higher risks than the Swedish-born (IRRs:

1.24 in Sweden, 1.12 in other Nordic countries, 1.42 in other European countries, 1.65 in Middle Eastern countries, and 2.89 in the rest of the world). Individual sociodemographic characteristics explained the excess suicide risk in rural municipalities, but not the excess risk in rural neighborhoods. Among women, urban residents showed higher suicide incidence than rural residents. We found no consistent patterning of interaction with nativities among women.

In Study 2, a repeated cohort study was designed using Swedish national register data between 1991 and 2015. To capture the dynamic changes in the population such as migration increases over time, five cohorts were created with five different analytic time periods. We set 1991 as the baseline year for the first cohort, and reset baselines at five-year intervals based on the registered information as follows; 1996, 2001, 2006, and 2011. Individuals were followed up until whichever was earliest; suicide, censoring, or the end of follow-up in 1995, 2000, 2005, 2010, and 2015, respectively. To evaluate rurality at the municipality level, we used population density tertile at the baseline year in each cohort. To evaluate rurality at the neighborhood level, we used DeSO area-level measure at the baseline year in each cohort. We also used the proportion of foreign-born people, the proportion of unemployed, and the proportion of people with the lowest income quintile per the neighborhood population.

We found a continuously high suicide rate among men who reside in rural areas in Sweden. Although in general, the suicide rate for men decreased over time in both urban and rural areas in Sweden, we observed fluctuations among foreign-born men residing in small rural communities, with high suicide rates in the 2000s. When we evaluated rurality at the municipality level, the proportion unemployed was associated with the excess suicide rate. On the other hand, when we evaluated rurality at the neighborhood level, the proportion of people with the lowest income quintile per the neighborhood population was partly associated with the excess suicide rate. Among women, suicide rates for all country of birth groups tended to decline only in urban areas between 1991 and 2015, whereas no such trend was observed in rural areas.

To summarize the two studies, we found that men in rural municipalities/neighborhoods had a higher suicide risk than those in urban areas regardless of country of birth, with a potentially stronger impact of residing in rural municipalities/neighborhoods among foreign-born men. The excess risk of suicide among men residing in rural municipalities/neighborhoods implies that the community context may have a negative effect on male rural residents. The cross-level interaction between rurality and country of birth on male suicide and the association between individual-level/area-level sociodemographic characteristics and urban-rural inequalities in male

suicide depended on the geographic unit used to assess rurality. When evaluating rurality at the municipality level, we observed an increased suicide risk from living in rural areas among men born in European countries, including native Swedes. The excess suicide risk among men residing in rural municipalities was explained by individual sociodemographic characteristics. Regarding area-level factors, the proportion of unemployed persons was continuously linked to the excess suicide in rural municipalities across the 25-year period. These results at the municipal level suggest that individuals residing in rural municipalities may have less access to economic resources and employment opportunities. When evaluating rurality at the neighborhood level, rurality was associated with an increased suicide risk in men for all country of birth groups, especially for those born in non-European countries. The excess risk in rural neighborhoods was not explained by individual-level sociodemographic factors and the proportion of the unemployed, but only partly by the proportion of low-income people. We speculate that income distribution and some psychosocial characteristics (e.g., ethnic discrimination) of smaller communities within municipalities might explain these findings. In contrast to men, among women, urban residents generally had a higher suicide incidence than rural residents. We discussed the possible role of restrictive gender norms (e.g., masculine norms like stoicism among rural men) in these gender differences in the relationship between rurality and suicide.

Public health policy should focus on individuals' access to resources in rural municipalities and income distribution and other community characteristics in smaller communities within municipalities to accomplish equitable health. It may be important to consider differences in characteristics between municipalities by rurality when it comes to providing public support, especially in relation to employment-related policies. Further research is needed to understand the pathways linking the community context to suicide risk, with a special focus on low-income neighborhoods and the potential risk for social exclusion and discrimination of specific ethnic groups. The health impact of the dispersion policies that directed refugees to settle in rural areas should be studied further.

Our finding of a differential suicide risk and the potential effects of residing in rural municipalities and rural neighborhoods warrants further study. Particularly, identifying relevant community characteristics, including local policies and cultural norms/behaviors, may contribute to public health interventions to prevent suicide and its inequalities by rurality, migration status, and gender. Moreover, greater investigation of gender norms as social determinants of health may help develop effective public health interventions to tackle regional inequalities in suicide.